ROLE OF GASTRIC LAVAGE AND BRONCHO-ALVEOLAR LAVAGE IN THE BACTERIOLOGICAL DIAGNOSIS OF CHILDHOOD PULMONARY TUBERCULOSIS

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CERTIFICATE

Certified that this dissertation entitled **"ROLE OF GASTRIC LAVAGE AND BRONCHO-ALVEOLAR LAVAGE IN THE BACTERIOLOGICAL DIAGNOSIS OF CHILDHOOD PULMONARY TUBERCULOSIS "** is the bonafide work done by **Dr.R. VASUMATHY**, Post graduate, Institute of Child Health and Hospital for Children, Madras Medical College, Chennai, during the academic years 2005-2008.

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ABBREVIATIONS USED IN THE STUDY

1.	GL	:	Gastric Lavage
2.	BAL	:	Broncho Alveolar Lavage
3.	PTB	:	Pulmonary Tuberculosis
4.	PCR	:	Polymerase Chain Reaction
5.	DNA	:	Deoxy Ribonucleic Acid
6.	RNA	:	Ribonucleic Acid
7.	DTH	:	Delayed type Hypersensitivity
8.	HIV	:	Human Immunodeficiency Virus
9.	PPD	:	Purified Protein Derivative
10.	BCG	:	Bacille Calmette Guerin
11.	IUATLD	:	International Union Against Tuberculosis and Lung Diseases
12.	WHO	:	World Health Organization
13.	SCC	:	Short Course Chemotherapy
14.	IAP	:	Indian Academy of Pediatrics
15.	AFB	:	Acid Fast Bacilli
16.	TBB	:	Trans Bronchial Biopsy
17.	EBTB	:	Endobronchial Tuberculosis
18.	LJ	:	Lowenstein Jensen
19.	BAS	:	Broncho Aspirate
20.	FB	:	Fiberoptic Bronchoscopy
21.	ATT	:	Anti Tuberculous Therapy
22.	TU	:	Tuberculin Units
23.	TB	:	Tuberculosis

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INTRODUCTION

Tuberculosis is a chronic bacterial infection caused by mycobacterium tuberculosis that is characterized by the formation of granulomas in infected tissues and by cell mediated hypersensitivity.

History

Tuberculosis appears to be a very old disease, perhaps as old as human history. Bones of prehistoric man dating back to 8000 BC have shown typical tuberculosis changes. Tuberculosis is recognizable in skeletons from the stone age and in mummified corpses from the Egyptian old kingdom [1,2]. In Chinese literature " Loaping", a disease of the lung with the symptom that fit with the tuberculosis has been mentioned.

In Rig Vedha which is dated 2000 BC, tuberculosis has been described as "Yakshma." sushruta described the disease and observed it was difficult to treat [3]. Hippocrates (459-377BC) opined that attention to the tuberculosis patients was waste of time. Some of the famous victims of tuberculosis include English Poet John Keats, French painter walteare, American philosopher Henry David Thoreu, Russian writer Anton Chekhov and North American liberator simon Boliver [4].

Tuberculosis was recognized as a clinical entity in the early 19th century by shonlein, who first used the term “tuberculosis” in 1830, and by Laennec in paris, among others.

Another French man parrot, first recognized that “whenever a bronchial node is tuberculous, there is a parenchymal lesion (parrot’s law 1876), although credit for extensively detailed description of primary focus goes to Anton Ghon (1866- 1936), professor of pathology in Prague. In 1882, Koch identified mycobacterium tuberculosis. The specific diagnostic tools essential to understand the disease in children were provided by Escharich, who in 1898 set in up Graz the first roentgenography for children; by Von Pirquet, Mantoux, Mendel and moro who developed Tuberculin testing between 1907 and 1910 and by meunier and delille, who in 1898 taught the usefulness of gastric lavage in children [5].

Magnitude of the problem

It is estimated that 1/3rd of the world’s population is infected with Mycobacterium Tuberculosis and that each year about 9 million develop tuberculosis, of whom 2 million die. Of the 9 million annual TB cases, about 1 million (11%) occur in children (under 15 years of age). Of these childhood cases 75% occur annually in 22 high- burden countries

that together account for 80% of the world's estimated incident cases. In countries worldwide, the reported percentage of all TB cases occurring in children varies from 3% to more than 25% [6].

In developing countries the annual risk of tuberculosis infection in children is 2-5%. Nearly 8-20% of the deaths caused by tuberculosis occur in children.[7]. Despite the availability of effective preventive measures and chemotherapy the prevalence of tuberculosis is increasing in the developing world and in much of the industrialized world as well.[8]

Etiology

There are five closely related mycobacteria in the mycobacterium tuberculosis complex. M tuberculosis, M.Bovis, M.Africanum, M.Microti and M.Canetti. All belong to the order Actinomycetales and the family Mycobacteriaceae, M.tuberculosis is the most important cause of tuberculosis disease in humans. The tubercle bacilli are Non-spore forming , Non motile, pleomorphic, weakly gram positive curved rods 2-4 micrometer long. They may appear beaded or clumped in stained clinical specimens or culture media. They are obligate aerobes that grow in synthetic media containing glycerol as the carbon source and ammonium salts as the nitrogen source (e.g.) Loewenstein Jensen culture Media [9]. These mycobacteria grow best at 37-41℃, produce

niacin, and lack pigmentation. Mycobacterium species have an unusal cell wall structure that contains N.Glycolylmuramic acid in lieu of N.acetylmuramic acid and has a very high lipid content. Because of this cell wall structure, are difficult to stain with commonly used basic aniline dyes such as those used in gram stain. However they resist decolorization by acidified alcohol (3% hydrochloric acid) after prolonged application of a basic dye or with heating. This important property of mycobacteria that it is dependent on its cell wall is referred to as acid fastness.[10] Another important feature is that they grow more slowly than most other human pathogenic bacteria because of their hydrophobic cell surface. Because of this hydrophobicity organisms tend to clump, so that nutrients are not easily allowed. Isolation from clinical specimens on solid synthetic media usually takes 3-6 weeks and drug susceptibility testing requires an additional 4 week, however growth can be detected in 1-3 week in selective liquid medium using radiolabeled nutrients (BACTEC radiometric system) and drug susceptibility takes another 3-5 days. It can also be detected within hours using nucleic acid amplification tests, including PCR that employ a DNA probe complementary to mycobacterial DNA or RNA.

Mode of Spread

Transmission of mycobacterium tuberculosis is from person to person, usually by airborne mucus droplet nuclei, particles 1-5micrometer in diameter that contain M.tuberculosis. The chance of transmission increases with smear positivity, an extensive upper lobe cavity, copious production of thin sputum, & severe and forceful cough.

Adult tuberculosis is considered to be the fountainhead of pediatric tuberculosis.[11] This is because children with tuberculosis rarely, if ever infect other children.[12]. Tubercle bacilli are sparse in the endobronchial secretions of children with pulmonary tuberculosis, and cough is often absent or lacks the tussive force required to suspend infectious particles of the correct size. The lifetime risk of developing tuberculosis [clinical disease] is approximately 10%.[13]

However in subjects who are immunosuppressed for any reason, preterm infants (or) preschoolers with grade III or IV malnutrition (or) HIV infection, the proportion who develop disease is much greater.[14]

Pathophysiology

The primary pulmonary complex includes the parenchymal focus and the regional lymphnodes. The lung is the portal of entry in 98% of cases. The bacilli multiply initially within alveoli and alveolar ducts.

Most of the bacilli are killed, but some survive within non activated macrophages, which carry them through lymphatic vessels to the regional lymphnodes.

About 70% of lung foci are subpleural and localized pleurisy is common. The hilar lymphnodes are usually involved, while an upper lobe focus may drain into the paratracheal nodes. The hallmark of primary TB is the relatively large size of the regional lymphnodes compared with lung foci. The tissue reaction intensifies over the next 2-12 weeks as the organisms grow in number and tissue hypersensitivity develops. The parenchymal portion often heals completely by fibrosis or calcification after undergoing caseation necrosis and encapsulation. As DTH develops, hilar & paratracheal nodes continues to enlarge in some children mostly infants, compressing the regional bronchus and causing obstruction. The usual sequence is hilar lymphadenopathy, focal hyperinflation and then atelectasis. The resulting radiographic shadows have been called collapse – consolidation or segmental tuberculosis. The inflamed caseous nodes can attach to the bronchial wall and erode through it, causing endobronchial tuberculosis or a fistulous tract.[9]

Progressive Primary Pulmonary disease

When the primary focus is progressively destructive, liquefaction may cause formation of a thin walled primary cavity associated with large numbers of bacilli. The enlarging focus may slough necrotic debris into adjacent bronchus, leading to further intrapulmonary dissemination.

Reactivation Tuberculosis

This form of tuberculosis is rare in childhood which usually represents endogenous reactivation of a site of previously established infection in the body.

The most frequent pulmonary sites are the original parenchymal focus or the apical seedings (Simon Foci). The most common radiological presentation are extensive infiltrates or thick walled cavities in the upper lobe.

Miliary tuberculosis

The most clinically significant form of disseminated tuberculosis is miliary disease, when massive numbers of tubercle bacilli are released into the blood stream due to erosion of a parenchymal focus of tuberculosis into the blood or lymphatic vessel causing disease in two or more organs.

Pleural Effusion

Tuberculosis pleural effusion, originate in the discharge of bacilli into the pleural space from a subpleural pulmonary focus or caseated lymphnode. Asymptomatic local pleural effusion is so frequent in primary tuberculosis that it is basically a component of the primary complex. It is infrequent in children <6years of age and rare in children <2 year of age and are usually unilateral. They are virtually never associated with a segmental pulmonary lesion and are rare in disseminated tuberculosis.

CLINICAL FEATURES

Incubation period: The incubation period varies between 4 and 8 weeks. The clinical features usually start with the development of hypersensitivity to tubercular proteins.

Onset: The onset is generally insidious but may be relatively sudden in cases of tuberculous meningitis or miliary tuberculosis.

Early Symptoms: The early clinical features of tuberculosis are vague and non-descript. The presenting features depend on the severity of infection and resistance of the host.

Over two-thirds of the children with primary complex are asymptomatic or they may have a mild transient illness which passes off unnoticed in a few days. In the remaining one-third of the patients, the child appears peevish, fretful and off-colour. He loses interest in play and is fatigued easily. His activity is reduced and the growth is slowed. There may be no weight gain.

Evidence of toxemia: The fever is generally low grade but may be high and hectic. The pulse rate is increased. The appetite is reduced and there is progressive loss of weight. Night sweats especially on the forehead are frequent and the child looks pale and ill [15] .

The primary complex has few localizing symptoms or signs. The cough is an inconstant symptom and may be absent even in the advanced disease. Bronchial and tracheal compression due to enlarged lymph nodes causes dry cough, which may be quite troublesome.

Primary complex with segmental collapse: Segmental atelectasis secondary to bronchial compression is sometimes termed epituberculosis. These patients often have a hectic temperature with dry cough and occasional wheezing. Long standing atelectasis predisposes to bronchiectatic changes.

Progressive primary complex and caseous bronchopneumonia: The child is very sick and toxemic. There is high fever with general malaise. The cough is often productive. The physical signs of consolidation or cavitation depend on the extent of the lesion.

Endobronchial Tuberculosis: These patients have fever and troublesome cough with expectoration. Dyspnea, cyanosis and wheezing may be present. .

Pleural Effusion: Clinically the onset is subacute with high fever, cough, discomfort and pain on the affected side of the chest. The pain becomes worse with deep breathing and coughing. Some patients with basal pleurisy may present with reflex pain in the abdomen. On physical examination, the affected side of the chest is less mobile, the intercostals space appear full, the mediastinum is shifted to the opposite side, vocal fremitus is decreased, percussion note is stony dull with a relatively higher level of dull note in the axilla (Ellis' curve). The breath sounds are distant, vocal resonance is decreased and egophony is elicited above the level of effusion.

Miliary Tuberculosis: The miliary tuberculosis in children usually occur within a year of the primary infection. The onset of the illness is sudden and may present in one of the following manner.

a. Pulmonary type: There is profound toxemia with moderate elevation of temperature, dyspnea and cyanosis. There are few clinical signs in the lungs. Some patients show fine crepitation, occasional rhonchi with features of obstructive emphysema. These features may simulate acute bronchiolitis in infancy.

b. Septicemic type: The illness is severe and the occurrence is fulminant. The high fever may or may not be associated with rigors. The child is delirious and there may be disturbances of sensorium. The illness resembles septicemia or a severe case of typhoid.

Meningitic type: The child appears irritable, he vomits frequently and has photophobia. He picks at bed clothes and has a shrill cry. Convulsions occur early and there may be a variety of neurological deficits.[15]

Diagnosis

Rosen in 1982 [16] reviewed the problem of diagnosis and treatment of childhood pulmonary tuberculosis in South Africa. Snider et al [17] and Farer and Snider [18] gave an over view of the subject as applicable to children of various ethnic groups in Atlanta (USA) in 1988. Crofton et al [19] have stressed on the clinical aspects of diagnosis of tuberculosis in children particularly for guidance of primary health center functionaries, paramedicals and doctors. Udani [20] highlighted the various aspects of childhood tuberculosis specially concentrating on neuro tuberculosis and massive pneumonia in children in India. Such spurts of literature, both from the developed and developing world focus categorically on one issue that childhood tuberculosis is a diagnostic problem due to absence of gold standard (like sputum positivity in adults) in most types specially the pulmonary and meningeal tuberculosis. It can occur in any part of the body and can present in unusual ways [21], and this poses a challenge to many a physicians diagnostic skills.

Thus tuberculosis persist despite the fact that modern medical signs have developed the tools virtually to eliminate, cure and prevent the disease if established public health principles are adhered to [18].

For most children the presence of positive tuberculin test, an abnormal chest radiograph consistent with tuberculosis and history of exposure to an adult with infectious tuberculosis is adequate proof that disease is present.

The tuberculin test is a useful diagnostic aid. Most frequently used test is Mantoux test.

Mantoux Reaction: 0.1ml of a suitable dilution of tuberculin (PPD) is injected intradermal on volar aspect of the forearm. Standard dose is 5 TU (equivalent to 1 TU PPD with RT 23 Tween 80). A wheal of 5 mm should be raised. The reaction is read after 48 hours to 72 hours. The dosage of tuberculin is measured in tuberculin units. Five tuberculin units are contained in 0.0001 mg of purified protein derivative (PPD) in 0.1 ml of diluent. Antigen should not be drawn into the syringe more than one hour before use. The PPD is obtained by culturing Mycobacterium tuberculosis H37RA strain with Tween 80 on a synthetic protein free medium quinosol.

An induration of more than 10mm is suggestive of natural infection. Natural infection under 2 years of age is suggestive of recent infection and should be treated. In children older than 2 years, natural

infection in association with history of contact or symptoms/signs or presence of risk factors has higher disease probability.

A negative tuberculin reaction does not rule out tuberculosis.

Tuberculin test in the vaccinated children; Children vaccinated previously with BCG show positive tuberculin reaction during infancy. In older children the interpretation of tuberculin test is not altered by the BCG status of the child.

False negative tuberculin reactions: A negative tuberculin reaction in a proven case of tuberculosis may be due to one of the following factors.

1. Test done in the incubation period of tuberculosis or before the hypersensitivity has developed.
2. The tuberculin reaction remains negative for several weeks following measles.
3. During corticosteroid therapy.
4. Overwhelming infection with tuberculosis e.g. tuberculous meningitis or miliary tuberculosis.
5. Severe malnutrition depresses the hypersensitivity.

6. Wrong technique. The injection might have been given subcutaneously instead of intradermal.

7. Inactive tuberculin. A).This may due to exposure of tuberculin to sunlight; b). The high temperature; or c). Storage for prolonged period after dilution.

The most specific confirmation of pulmonary tuberculosis is isolation of mycobacterium tuberculosis. The best culture specimen in young children is the early morning gastric juice obtained before the child has arisen and peristalsis has emptied the stomach of the pooled secretions that have been swallowed overnight.[9]

Bronchoscopy first saw clinical application in 1897 when killian removed a pork bone from the right main bronchus of a German farmer. The early clinical applications of bronchoscopy were limited to the removal of foreign bodies. As illumination and optical technology improved, wider application became realized. Wood and flink [22] first described use of the flexible bronchoscope in children in 1978. Fiberoptic bronchoscopes small enough for use in children became widely available in 1981. Since then the rise in flexible bronchoscopy has been relentless.

The flexible bronchoscope consists of bundles of optic fibers, rendering the instruments inherently delicate. The bronchoscope contains fibers dedicated to making the image, fibers which deliver light to the tip, and a working channel through which suction is applied and instruments passed. The picture is made of pixels, each one representing a single glass fiber. The end of the bronchoscope is steerable through an arc of 220 degrees permitting visualization of the entire airway. The most popular flexible pediatric bronchoscope has a 3 .6mm external diameter and a 1.2 mm working channel (Olympus BF 3C20).[23]

BRONCHO ALVEOLAR LAVAGE

Broncho alveolar lavage samples the alveolar epithelial lining fluid directly and has been found to be useful in the diagnosis of several respiratory infections including tuberculosis .[24] BAL differs from bronchial washings which refer to aspiration of either secretions or small amounts of instilled saline from the large airway. [25] Norman et al [38] reported that BAL is better than gastric lavage in the diagnosis of pulmonary tuberculosis in adults showing just the opposite that gastric lavage is better than BAL and BAL does not improve the isolation of mycobacterium tuberculosis in children suspected of pulmonary tuberculosis.

When the pathology is localized, BAL is obtained from the affected segment. When it is diffuse, BAL is performed from the lingual and the right middle lobe because of the favourable anatomical location, ease of obtaining a good wedge and higher volume of returning fluid as compared to the other lobes. [26]

Pediatric Flexible bronchoscopy allows demonstration of endobronchial tuberculous lesions and permits collection of specimen for mycobacterial studies. Demonstration of endobronchial lesion and extrinsic compression (lymphnodes) occluding more than 50% of main stem bronchi, is a useful guide to initiate prednisolone therapy. [27]

TREATMENT OF TUBERCULOSIS:[15]

Principles of Treatment: The treatment of tuberculosis has undergone many changes over the past two decades. The short course chemotherapy was started in 1972 but only recently accepted by IUATLD. WHO & American Academy of Pediatrics.

1. The diagnosis should be made early
2. The treatment should be prompt, adequate, vigorous and prolonged depending on the severity of the illness.

3. More than one antitubercular drug should be used for prevention of delayed development of resistance of the tubercle bacilli to the drugs.

4. All drugs should be given in a single daily dose on empty stomach.

5. Pyridoxine (vitamin B6) is not necessary in children taking isoniazid.

6. Nutrition of the child should be improved by an appetizing, nutritionally balanced diet with adequate calories and protein.

7. Intercurrent infection should be prevented or treated vigorously.

8. Every effort should be made to trace the reservoir of infection or the open infective case in the family or extra familial contacts and he or she should be treated.

9. The living condition should be improved by better hygienic measures and improved sanitation. The child should be exposed to adequate sunshine and the living apartment should be well ventilated.

Antituberculous Regimen: Newly diagnosed patients of pulmonary and extra pulmonary tuberculosis are now a days treated with short course chemotherapy (SCC) regimen. The standard SCC regimen consists of two phases. Intensive phase; The goal of this phase is to eliminate the bacterial load and prevent the emergence of drug resistant strains. At least three bactericidal drugs are used during this phase to initiate the therapy. Continuation phase; During this phase, at least two bactericidal drugs are used to continue and complete the therapy.

TREATMENT REGIMENS FOR TUBERCULOSIS; IAP RECOMMENDATIONS [28]

Group	**Clinical Presentation**	**Description of Therapy**
1.	a. Asymptomatic Mantoux positive aged <3 years b. Asymptomatic Mantoux positive aged <5 years with Grade III or IV malnutrition. c. Children <3 years with history of contact d. Children <5 years with history of contact with Grade III or IV malnutrition. e. Recent converter, no signs but Mantoux positive	6HR
2.	a. Primary complex	

	b. Symptomatic Mantoux positive <3 years without localization c. Symptomatic Mantoux positive <5 years with Grade III or IV malnutrition without localization d. Isolated lymphadenitis e. Pleural effusion	2HRZ + 4HR
3.	a. Progressive pulmonary disease b. Tubercular Lymphadenitis involving multiple nodes. Extend continuation phase by 3 months in event of non-resolution.	2HRZE+ 4HR
4.	a. Miliary tuberculosis b. Disseminated tuberculosis c. Cavitatory tuberculosis d. Tubercular bronchopneumonia e. Bone and joint tuberculosis f. Abdominal, pericardial or genitourinary tuberculosis	2 HRZE + 7HR
5.	CNS tuberculosis; i.e. tuberculoma or tubercular meningitis	**2 HRZE** + 10HRE

DRUG COMMONLY USED IN THE TREATEMENT OF TUBERCULOSIS

Drug	Daily dose	Route	Adverse reactions
Rifampicin	10mg/kg single dose on empty stomach (max.600mg)	Orally	Hepatotoxic, (incidence 1%) dermatitis, flu like syndrome, thrombocytopenia, hemolytic anemia, acute renal failure.
`Isoniazid (INH)	5mg/kg (max. 300mg)	Orally	Peripheral neuritis, toxic encephalopathy, optic neuritis, convulsions, psychosis, hepatitis, aplastic anemia and hypersensitivity reaction.
Streptomycin	20mg/kg (single, max.1 g)	IM	Auditory or vestibular dysfunction
Ethambutol	20mg/kg divided doses	Orally	Retrobulbar neuritis (blurred vision), color blindness, visual field defects.
Pyrazinamide	25mg/kg (divided, max 1g)	Orally	Hepatotoxicity

REVIEW OF LITERATURE

Abadco DL, Steiner P et al. [29] Division of Pediatric pulmonology, Children's Medical Center of Brooklyn, Ny 11203.

Gastric Lavage is better than Bronchoalveolar lavage for isolation of Mycobacterium tuberculosis in childhood pulmonary tuberculosis.

They have compared the sensitivity of gastric lavage (GL) with bronchoalveolar lavage (BAL) for isolating Mycobacterium tuberculosis (Mtb) from 20 children with a presumptive diagnosis of primary pulmonary tuberculosis. GL was performed on three consecutive mornings after an overnight fast .BAL was performed on the same day as the last GL. Specimens were submitted for smears and culture for Mtb. None of the acid-fast stained smears was positive. Culture of BAL fluid on 2 patients (2 of 20 or 10%) were positive for Mtb. Cultures of the gastric aspirates from the same 2 patients were also positive for Mtb. Eight additional patients had positive GL cultures with negative BAL cultures, resulting in a total of 10 of 20 (50%) patients with positive GL cultures for Mtb.

Conclusion

The result of the study indicates that GL done on three consecutive days is better than BAL for the bacteriologic diagnosis of childhood pulmonary tuberculosis.

Somu N, Swaminathan S et al. [30]

Department of Pediatric Pulmonology, Institute of Child Health and Hospital for Children, Egmore, Chennai, India.

Value of bronchoalveolar lavage and gastric lavage in the diagnosis of pulmonary tuberculosis in children.

Objective: The aim of the study was to find out if bronchoalveolar lavage (BAL) would be better than gastric lavage for the isolation of Mycobacterium tuberculosis from pediatric patients with suspected pulmonary tuberculosis. Design: 50 children with suspected tuberculosis at a mean age of 5.1 years (range 7 months to 12 years) were studied. Early morning gastric lavage was collected. Flexible bronchoscopy and bronchoalveolar lavage were performed under local anaesthesia after obtaining informed consent from the parents. The BAL fluid and gastric lavage specimens were subjected to smear examination for acid-fast bacilli (AFB) and culture for mycobacteria using established methods.

Results: of the 50 cases, M.Tuberculosis was grown in 6 BAL samples (12%) and 16 gastric lavage samples (32%) making a total of 17 culture proven cases (34%). Out of the 6 BAL positive cases, gastric lavage was also positive in 5 cases. Conclusion: They have concluded that gastric lavage is better than BAL for bacteriologic confirmation of pulmonary tuberculosis in children. The overall bacteriologic yield combining both procedures was 34% while gastric lavage alone was positive in 32% of the cases.

Meenu Singh, N.V. Ahsan Moosa, et al [31]

From the Department of Pediatrics and Microbiology, Post Graduate Institute of Medical Education and Research, Chandigarh 160 012, India.

Objective: To compare the mycobacteriological yield from gastric lavage (GL) and bronchoalveolar lavage (BAL), in children with pulmonary tuberculosis. Methods: 58 Consecutive children with chest radiograph suggestive of tuberculosis and positive Mantoux test or a positive history of family contact with a case of tuberculosis were prospectively subjected to gastric lavage on three consecutive mornings and broncho-alveolar lavage on the last day. The samples were subjected to bacteriological isolation. Results: Samples from 10 (17.2%)

children grew Mycobaterium tuberculosis from gastric lavage and 12 children had their BAL positive for this bacteria ($p>0.05$). Overall mycobacterial isolation was possible in 20 patients (34%) as two children had grown mycobacterium tuberculosis in GL as well as BAL. Addition of BAL to the diagnostic work up increased the mycobacteriological yield from 17.2% with gastric lavage alone to 34.4% when BAL was also performed ($p=0.013$). Conclusion: There is no difference in mycobacterial isolation rates from gastric lavage and BAL when studied in isolation. However, when both GL and BAL are used; these procedures complement each other to double diagnostic yield.

Dickson S J, Brent A et al. [32]

Department of Infection and Tropical Medicine, Lister Unit, Northwick Park Hospital, Harrow, Middlesex, United Kingdom.

Comparison of Bronchoscopy and Gastric washings in the investigation of smear-negative pulmonary tuberculosis.

This study compares the utility of gastric washings (GWS) and bronchoscopy in the diagnosis of smear-negative pulmonary tuberculosis (TB). The aim of the study was to identify which

investigation or combination of investigations provided the greatest yield of positive mycobacterium tuberculosis cultures of samples from patients with smear-negative pulmonary TB. They had retrospectively analyzed the medical records of 180 patients with smear – negative pulmonary TB. They found the positive culture yield for bronchoalveolar lavage fluid (62 (34%) of 180 patients) was significantly greater than that for specimens from 3 Gastric washings (32 (21%) of 149 patients) (p=0.02). Combining GW and bronchoscopy increased the positive culture yield.

Conclusion

Bronchoscopy combined with 2 GWS resulted in a positive culture rate of 38%. Bronchoscopy is superior to GW in the diagnosis of smear-negative pulmonary TB; however, the combination of bronchoscopy and 2 GWS should be regarded as optimal for the diagnosis of smear – negative pulmonary TB.

Charoenratanakul S, et al. [33]

Department of Medicine, Siriraj Hospital Bangkok, Thailand.

Diagnostic role of fiberoptic bronchoscopy in suspected smear negative pulmonary tuberculosis.

Fiberoptic bronchoscopy with bronchoalveolar lavage (BAL) and transbronchial biopsy (TBB) was performed in 40 patients suspected to have pulmonary tuberculosis, in whom chest roentgenogram revealed minimal infiltration and sputum smears were negative for acid-fast bacilli. Bronchoscopic procedures provided overall diagnostic yield in 47.5% (19/40) of patients. The diagnostic yield of overall bronchoscopic procedures for tuberculosis in the study was 32.5% (13/40) of patients. It consisted of positive BAL smear in 7.5% (3/40) of patients, positive for mycobacterial culture in 15% (6/40) of patients and TBB revealing granuloma in 17.5% (7/40) of patients. Non-tuberculosis conditions were diagnosed by the bronchoscopic method in six patients (15%). They suggest that in an area with a high prevalence of tuberculosis, bronchoscopic procedures should be performed in those cases in which other diagnoses such as malignancy must be ruled out. Transbronchial biopsy has a major role for early diagnosis and should be performed in all cases, if possible.

Caminero Luna JA, Rodriguez de Castro F et al [34].

The efficacy of bronchoalveolar lavage in the diagnosis of pulmonary tuberculosis.

In order to analyze the usefulness of bronchoalveolar lavage (BAL) for conventional microbiological diagnosis of tuberculosis (TB) and other mycobacteria and to assess the need to use it or not as a routine diagnostic technique in these disease.They have studied 30 patients with mycobacteria (26 TB and 4 Mycobacterium avium-intracellulare infections) by bronchoscopy, with BAL and bronchoaspirate (BAS) bacteriological analyses also available. The result were compared with those obtained for sputum taken before and after bronchoscopy when these specimens were available. The overall yield for BAL and BAS cultures was 90%, with BAL (83.3%) specimens being more productive than BAS (73.3%) specimens. Both performed far better than the 53.8% recorded for cultures of pre-bronchoscopy sputum and 60% for post – bronchoscopy sputum. BAL was the only diagnostic specimen from 7 patients, while BAS the only one from 4. The results for direct bacilloscopy, however at 30% for the two specimens, rose to 36.6% when they were analyzed together with BAS and BAL. They have concluded that bronchoscopy should be

performed on all patients suspected of mycobacterial infection when sputum bacilloscopy is negative and patients have no expectoration. Performance of BAL should be routine since this simple and usually uncomplicated technique produces the most productive specimens.

Ledesma Albarran JM, Perez Ruiz E, Fernandez V et al. [35]

Endoscopic Evaluation of Endobronchial Tuberculosis in Children:

The aim of this study was to determine the role of fiberoptic bronchoscopy (FB) in pulmonary tuberculosis in children. They have assessed bronchoscopic findings of 36 procedures performed in 30 children who presented the following abnormalities on chest films: lobular or segmentary atelectasis (17), paratracheal or parahilar adenopathies (14), parenchymatous consolidation (9) and localized hyperinflation (5). Premedication for FB included intravenous atropine and diazepam plus ketamine for sedation, as well as lidocaine 2 and 5% in aerosol form for topical anesthesia. FB results showed that involvement was endobronchial in 29 patients. In the 18 patients with x-rays suggestive of endobronchial tuberculosis (EBT), the diagnosis was confirmed by FB. Significantly, EBT was found by FB in 11 (36.6%) patients with no clinical or radiological signs of such involvement. EBT was in the early stages in 3 (10%) patients and was advanced in 8

(26.6%). M tuberculosis was isolated in 9 (30%) of the 30 patients. Culture was of bronchoalveolar lavage in three, of gastric lavage in four and of endobronchial biopsy in two. They have concluded that FB is a safe, important tool for the confirmation of EBT in the management of pulmonary tuberculosis in children. It serves as a guide for the start of steroid treatment, especially in children with no radiological suggestion of EBT.

Okutan O, Kartaloglu Z, Kilic E et al [36]

Department of pulmonary diseases, GATA Haydarpasa Training Hospital 81020 Acibadem, Istanbul, Turkey.

Diagnostic Contribution of Gastric and Bronchial lavage Examinations in Cases suggestive of pulmonary tuberculosis.

They have assessed whether acid fast bacilli (AFB) determination in gastric lavage (GL) and bronchial lavage (BL) contributes to diagnosis in cases radiologically suggestive of pulmonary tuberculosis but with either cases recruited for the study, 22 were excluded due to evaluation as inactive disease or non-tuberculosis disease. The remaining 107 cases were evaluated in 2 groups. Group A consisted of 49 patients that could not expectorate sputum and from whom GL was

obtained. In group B, BL was performed in 58 patients that had negative sputum smear. Smear positivity was 61.2% (30/49) and culture positivity was 30.6% (15/49) in group A, 51.7% (30/58) and 81% (47/58), respectively in group B). Thirteen cases, in whom AFB could not be detected microbiologically but who were radiologically strongly suggestive of tuberculosis were regarded as tuberculosis according to "from treatment to diagnosis" criteria. Conclusion; Detection of AFB positivity in the diagnosis of tuberculosis is important in terms of early initiation of treatment of detection of resistance bacilli. Therefore, they suggest that it would be helpful to obtain GL in cases where the patient is unable to expectorate sputum, and perform BL in cases with negative sputum smear.

De Gracia J, Curull V, Vidal R et al. [37]

Diagnostic Value of Bronchoalveolar lavage in Suspected pulmonary Tuberculosis:

Of 222 patients suspected of having pulmonary tuberculosis (PT), studied during a one-year period, they performed fiberoptic bronchoscopy together with bronchoalveolar lavage (BAL), bronchial washing and postbronchoscopy sputum smears and Lowenstein cultures in 20 patients. Bronchoalveolar lavage proved to be the most effective

method leading to diagnosis in 17 of 20 cases. Diagnosis was obtained in 11 of 20 cases using bronchial washing and postbronchoscopy sputum. The results of this study suggest that bronchoscopy may be required in selected cases for the diagnosis of PT. However, it should be accompanied by BAL, bronchial washings and postbronchoscopy sputum smears. Indications for bronchoscopy as a diagnostic tool for PT may include; (a) patients suspected of having PT with negative smears and in whom treatment must be started due to clinical status; (b) suspicion of associated neoplasia; (C). selected patients with negative lowenstein cultures; (d) lack of material being obtained by simpler methods.

Norrman E, Keistinen T, Uddenfeldt M et al [38].

From the department of Lung Medicine, University Hospital, Umea, Sweden.

Bronchoalveolar Lavage is better than Gastric Lavage in the diagnosis of pulmonary tuberculosis:

Bronchoalveolar lavage was performed in 62/63 patients with suspected pulmonary tuberculosis and gastric lavage in 60 of the 63. Mycobacteria could be cultured from 14 of the patients. Culture on

bronchoalveolar lavage were positive in 13 of them while gastric lavage was positive in only 7. Conclusion: They have concluded that bronchoalveolar lavage should be performed instead of gastric lavage when pulmonary tuberculosis is suspected.

Zajaczkowska J, Zalewska- Schonthaler N et al [39]

The Role of Bronchoscopy and Bronchoalveolar lavage in diagnosis of pulmonary tuberculosis in AIDS.

Bronchoscopy was carried out in 32 HIV seropositive patients, most with AIDS during the period between January 1992 and August 1993. In 14 patients tuberculosis was diagnosed, in 13 it was bacteriologically confirmed. The mean age of the examined patients was 35.5 years (range 22-49 years). In 50 percent of the BAL samples bacterioscopy was positive.Bacteriological examination of the sputum and BAL fluid (bacterioscopy and culture) produced a confirmation of tuberculosis in 99.9% of the cases.

Mohan A, Panda JN, Sharma S K, Rattan A, et al [40]

From the Department of Medicine All India Institute of Medical Sciences, New Delhi.

Bronchoalveolar lavage in pulmonary tuberculosis, a decision analysis approach:

They have assessed the utility of bronchoalveolar lavage (BAL) in the diagnosis of pulmonary tuberculosis (PTB) in 50 consecutive HIV – negative patients with clinical and radiographic findings suggestive of PTB, but with negative microscopy for acid-fast bacilli (AFB) on sputum smear. Patients were grouped, using a scoring system, into relative likelihoods of having PTB (I-IV, in descending probability). Patients were started on anti-tuberculosis treatment according to the BAL results.

Bacteriological diagnosis of PTB was confirmed in 22/50 BAL; 11 (9136%) seven (37%) and four (40%) of groups I-III respectively, in 13 cases an early diagnosis of PTB was made by positive microscopy for AFB on BAL; an alternative diagnosis was made in six cases (bacterial pneumonia 4, Carcinoma 2). A decision analysis model was created to assess the overall utility of BAL. They have suggested that in a region

of high PTB prevalence, and when the clinical diagnosis of PTB is likely, empirical treatment is the best course of action, with BAL being reserved for further investigation of non-responders. Early BAL should be considered when the diagnosis of PTB is uncertain.

Wang AC, Wu B. et al. [41]

Department of Respiratory diseases, Afilliated Hospital of Bengbu Medical College, Anhui.

Diagnostic Value of Fiberbronchoscopy on pulmonary tuberculosis:

Results of fiberbronchoscopy in 89 patients with pulmonary tuberculosis were reported. Among them, lesions were located in the right in 49, left 20 and bilateral 1 cases. The total positive rate of brushings was 80.28% and of BAL 85.7%, both significantly higher than of biopsy (42.55%). In the area of the congested, swollen and coarse bronchial mucosae, brushings and BAL respectively gave positive rates of 86.36% and 90.91% statistically greater than biopsy (21.88%). But biopsy of the granulations and nodules was positive for 100%, while brushings for 50% ($p<0.01$). When bronchoscopy revealed no obvious abnormality of the visible airways, the positive rate of BAL (80.0%) was remarkably higher than of biopsy (50%).

JUSTIFICATION OF THE STUDY

The diagnosis of childhood tuberculosis is complicated by the absence of a practical gold standard test due to the difficulty of collecting bacteriological specimens and the reportedly low bacteriological yield.

Bacteriological confirmation is rarely attempted in children, particularly in areas where tuberculosis is highly endemic, because of resource limitations and the expected low yield. However, bacteriologic confirmation may have particular value in these areas, where epidemiological indicators such as known exposure to proven infection with mycobacterium tuberculosis contribute little diagnostic value[42].

In addition to providing a definitive diagnosis, isolation of mycobacterium tuberculosis offers opportunities for drug susceptibility testing and molecular investigation. Gastric Lavage collects the respiratory secretions which are swallowed at night. BAL samples the alveolar epithelial lining fluid directly and has been found to be useful in the diagnosis of several respiratory infections including tuberculosis[24]. Hence this study is undertaken to compare the mycobacteriological yield from Gastric lavage and BAL in children with suspected pulmonary tuberculosis.

AIM OF THE STUDY

- To compare the mycobacteriological yield from GASTRIC LAVAGE and BRONCHOALVEOLAR LAVAGE in children with pulmonary tuberculosis.

SUBJECTS AND METHODS

Methodology

1. Study Design	**:**	Descriptive Study
2. Study Place	**:**	Institute of Child Health & Hospital for Children , Egmore, Chennai.
3. Study Duration	**:**	December 2005-May 2007
4. Study Population	**:**	Children in the age group of 0 to 12 years with suspected pulmonary tuberculosis are included in the study.

5. (a).Inclusion Criteria:

- A provisional diagnosis of pulmonary tuberculosis made in the presence of the following criteria are included in the study.

- Abnormal chest x-ray suggestive of tuberculosis like Intrathoracic Adenopathy, Segmental lesion like consolidation, Collapse, Miliary appearance, unresolving pneumonia of more than 3 weeks, cavitory lesion with.

- Positive mantoux test which is taken as 10mm or more induration at 48-72hrs following ITU of PPD intradermally or/ and

- Positive history of contact

(b). Exclusion Criteria: Children who are started on ATT or children who had ATT in the past.

6. Manoeuvre:

Children in the age group of 0-12 years with persistent parenchymal lesions after an adequate course of antibiotics such as Intrathoracic adenopathy, consolidation, collapse, miliary appearance, chronic cavitory lesion, with a positive history of contact (Definition, Child living in a house with an adult source who is on antituberculosis

treatment or who had completed treatment within two years) or Positive mantoux (0.1ml of 1TU PPD RT tween 80 is given intradermally and read after 48 hrs. More than 10mm. Induration is taken as positive) are included in this study.

For these children a detailed history including the presenting complaints, past history of hospitalization, past history of antituberculosis therapy, past history of any chronic lung disease were taken.

Thorough clinical examination with assessment of nutritional status, general examination, assesment of BCG scar, respiratory system and other system examination were done.

GASTRIC LAVAGE

Gastric lavage collects the respiratory secretions which are swallowed at night. For all the children included in this study resting gastric juice analysis by gastric lavage was done on three consecutive mornings.

Procedure

A nasogastric tube was instilled and 20 to 30ml of 0.9% normal saline was used for gastric lavage. The lavaged specimen was sent to the

department of Microbiology for staining by Zeihl Neelson technique – Smear for AFB and culture in L-Jmedium..

Flexible fibre optic Bronchoscopy

Olympus BF 3C30 3.5mm Bronchoscope was used in a bronchoscopy suite. An informed written consent was obtained. After overnight fasting, the procedure was done under local 2% lignocaine anaesthesia through nasal route in all the patients. The vocal cords were anesthetized by spraying 2% lignocaine. After inspecting the normal side, the affected side was examined. Throughout the procedure, vital parameters and oxygen saturation were monitored. A thorough intraluminal examination was done.

BAL

BAL samples the alveolar epithelial lining fluid directly and has been useful in the diagnosis of tuberculosis.When lesions suggestive of EBTB were visualized the bronchoscope was advanced into the most involved area and wedged or into a segment of the right middle lobe if the lesion was diffuse. 1- 2ml/kg of sterile 0.9% normal saline was instilled through the suction port and subsequently aspirated by suction into the mucus trap in aliquots. After the procedure the samples were immediately sent for staining and culture.

Smear for AFB

Smear of both gastric lavage and BAL specimens were stained by Zeihl Neelson technique. The smears were covered with carbol fuchsin and gently heated intermittently until steam rises for 5-7 minutes. The slide in then washed with water and decolourized with 20% sulphuric acid till the smear is only faintly pink.After washing, the smear is counterstained with Loeffler's methylene blue for 1minute and washed.After blot drying,the smear was viewed under the oil immersion objective, acid fast bacilli are seen as pink to red rods while the background is blue. A positive report is given only if two or three typical bacilli are seen.

Culture in LJ medium

The specimen were inoculated into the standard LJ medium and incubated at 37°-38℃ for six weeks. The culture were checked weekly for any growth. The organisms were identified by colony morphology and standard biochemical reactions. The results were tabulated and analysed using SPSS for WINDOWS version 11.0 Stastistical analysis were done using Chi-square test.

OBSERVATIONS

A total of 61 children were included in the study during the study period. 37 (60.6%) were Male children and 24 (39.3%) were Female children.

SEX DISTRIBUTION IN THE STUDY POPULATION
n = 61

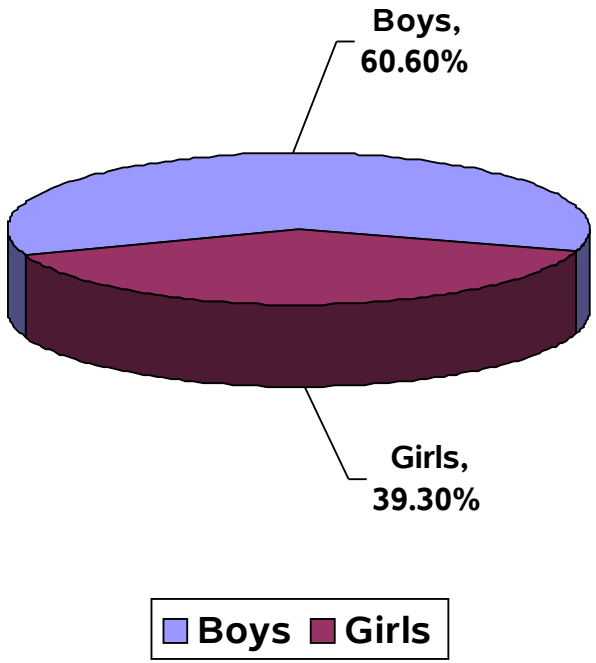

TABLE-1

AGE AND SEX INCIDENCE IN CHILDREN WITH SUSPECTED PULMONARY TUBERCULOSIS n=61

Age	Consolidation		Bronchopneumonia		Consolidation with collapse		Cavitory lesion		Intrathoracic Lymphadenopathy		Others		Total
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	
<1yr	3	2	7	1	1		1	2				1	18 (29.5%)
1-4yrs	7	6	1	1		1	2	1		1	2		22 (36%)
5-8yrs	4	3			1	1			1			1	11 (18%)
9-12yrs	3	1	1		1				1	1	1	1	10 (16%)
Total	**29 (47%)**		**11 (18%]**		**5 (8%)**		**6 (10%)**		**4 (6.5%)**		**6 (10%)**		**61**

The Major radiological features were consolidation in 29 (47%) ,bronchopneumonia in 11(18%), Cavity in 6 (10%), Consolidation with Collapse in 5 (8%), Intrathoracic Lymphadenopathy in 4 (6.5%), Miliary TB in 1 (1.6%), Bronchiectasis in 2 (3.2%) and pleural effusion in 2 cases (3.2%) and Chest X-ray was normal in 1[1.6%]. The observed age distribution was 18 less than 1 year (29.5%), 22 (36%) between 1-4 years of age, 11 (18%) between 5-8 years and 10 (16%) between 9-12 years of age.

TABLE - 2

CHARACTERISTICS OF CONSOLIDATION IN CHILDREN WITH SUSPECTED PULMONARY TUBERCULOSIS n=29

Age	n %	Mantoux		Contact		GL	
		Positive	Negative	Positive	Negative	Positive	Negative
<1 yr	5(17%)	2	3	5		1	4
1-4 yrs	13(45%)	9	4	5	8	3	10
5-8 yrs	7 (24%)	4	3	3	4	2	5
9-12 yrs	4(14%)	2	2	2	2	3	1
Total	**29(47.5%)**	**17 (58%)**		**15 (52%)**		**9 (31%)**	

- Among the 29 cases of consolidation 5 (17%) were less than 1 year of age 13 (45%) between 1-4 years, 7 (24%) between 5-8 years) and 4 (14%) between 9-12 years of age.
- Positive Mantoux was found in 17 (58%) of cases with consolidation & Positive History of contact was present in 15 (52%) of cases. GL was positive in 9 (31%) of cases among consolidation.
- BAL was positive in 6 (21%) of cases

TABLE - 3

BRONCHOSCOPY FINDINGS IN CONSOLIDATION n=29

Age	Chronic Airway inflammation	Acute Airway Inflammation	Normal	EBTB	E com a
<1 yr	**2**	**1**		**1**	
1-4 yrs	**5**	**3**	**2**	**3**	
5-8 yrs	**3**	**2**	**2**		
9-12 yrs	**2**	**1**	**1**		
Total	**12 (41%)**	**7 (24%)**	**5 (17%)**	**4 (14%)**	

The bronchoscopic findings among the 29 cases of consolidation were chronic inflammation of the airways in 12 (41%), acute inflammation of the airways in 7 (24%), normal study in 5 (17%), EBTB 4 (14%) and 1 (3%) had external compression of the airways.

TABLE-4

CHARACTERISTICS IN BRONCHOPNEUMONIA n=11

Age	n %	Mantoux		Contact		GL		BAL	
		Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
<1 yr	8 (72%)	2	6	7	1	1	7	5	3
1-4 yrs	2 (18%)	1	1	1	1	1	1	1	1
5-8 yrs									
9-12 yrs	1 (9%)	1		1			1	1	
Total	**11 (18%)**	**4 (36%)**		**9(82%)**		**2 (18%)**		**7 (64%)**	

- Among the 11 cases of bronchopneumonia, 8 (72%) were less than 1 yr of age, 2 (18%) patients between 1-4 years, 1 (9%) between 9-12 years of age.
- A positive Mantoux was present in 4 (36%) and a positive history of contact was present in 9 [82%] of patients. GL was positive in 2 (18%) of patients. BAL was positive in 7 (64%) of patients

TABLE-5

BRONCHOSCOPIC FINDINGS IN BRONCHOPNEUMONIA
n=11

Age	Chronic Airway Inflammation	Acute Airway Inflammation	Normal	EBT
<1 yr	2	1	3	2
1-4 yrs	2			
5-8 yrs				
9-12 yrs		1		
Total	**4 (36%)**	**2 (18%)**	**3 (27%)**	**2 (18**

The bronchoscopic findings among 11 cases of bronchopneumonia were chronic inflammation of airways in 4 (36%), acute inflammation of airways in 2 (18%), Normal Study in 3 (27%), EBTB in 2 (18%) of patients.

TABLE-6

CHARACTERISTICS AND BRONCHOSCOPY FINDINGS IN CAVITY n=6

Age	Mantoux		Contact		GL		BAL		Br Acute Airway inflammation
	Pos.	**Neg.**	**Pos.**	**Neg.**	**Pos.**	**Neg.**	**Pos.**	**Neg.**	
<1 yr	2	1	1	2	1	2	1	2	1
1-4 yrs	1	2	2	1		3	1	2	2
5-8 yrs									
9-12 yrs									
Total	**3 (50%)**		**3 (50%)**		**1 (17%)**		**2 (34%)**		**3 (50%)**

Among the 6 cases of cavity 3 (50%) were less than 1 year of age, 3 (50%) between 1-4 years of age, A positive Mantoux was found in 3 (50%) and a positive history of contact was found in 3 (50%) of patients.

GL was positive in 1 (17%) and BAL was positive in 2 (34%) of patients. Bronchoscopy findings were acute inflammation of airways in 3 (50%) endobronchoial TB in 2 (33%), Normal airways in 1 (17%) of patients.

TABLE-7

CHARACTERISTICS AND BRONCHOSCOPY FINDINGS IN CONSOLIDATION WITH COLLAPSE n=5

Age	Mantoux		Contact		GL		BAL		Br	
									Acute Airway inflammation	I
	Pos.	**Neg.**	**Pos.**	**Neg.**	**Pos.**	**Neg.**	**Pos.**	**Neg.**		
<1 yr		1	1			1	1			
1-4 yrs	1			1		1		1		
5-8 yrs	1	1	1	1		2		2	1	
9-12 yrs	1			1	1			1		
Total	**3 (60%)**		**2 (40%)**		**1 (20%)**		**1 (20%)**		**1 (20%)**	

Among 5 cases of consolidation with collapse ,1 (20%) were less than 1 year and 1 (20%) between 1-4 years of age, 2 (40%) between 5 -8 years of age and 1 (20%) between 9-12 years of age.

A positive mantoux was present in 3 (60%) and a history of contact was present in 2 (40%) of patients. Bronchsocpic findings were chronic inflammations of airways in 2 (40%), Acute inflammation of airways in 1 (20%) and EBTB in 2 (40%) of patients.

GL was positive in 1 (20%) and BAL was positive in 1 (20%) of patients.

Among 2 cases of bronchiectasis, mantoux was positive in 1 (50%) and contact was positive in both (100%) of patients.

Among 4 cases of Intrathoracic lymphadenopathy, mantoux was positive in 2[50%] and positive history of contact in 2[50%].

Bronchoscopic findings were EBTB in 2[50%],1[25%] had external compression of airway,1 with normal mucosa.

TABLE-8

CHARACTERISTICS OF EBTB IN CHILDREN WITH SUSPECTED PULMONARY TUBERCULOSIS

n=16

Age	Mantoux		Contact		Radiology								BCG Scar		GL	BAL
	Pos.	Neg.	Pos.	Neg.	Cons. With Collapse	Cons.	Cavity	Broncho pneumonia	Intra thoracic Adenopathy	Miliary TB	Bronchiectasis	Pleural Effusion	Pos.	Neg.	Pos.	Pos.
<1 yr	4	3	4	3	1	1	2	2		1			5	2	1	5
1-4 yrs	4	1	2	3		3					1		4	1	2	3
5-8 yrs																
9-12 yrs	3	1	1	3	1				2			1	4		1	1
Total	**11 (68%)**		**7 (44%)**		**2 (12%)**	**4 (25%)**	**2 (12%)**	**2 (12%)**	**2 (12%)**	**1 (6%)**	**1 (6%)**	**1 (6%)**	**13 (81%)**	**3 (19%)**	**4 (25%)**	**9 (56%)**

- Among 16 cases of EBTB 7 (44%) under 1 year of age, 5 (31%) between 1-4 years, 4 (25%) between 9-12 years of age.

- Mantoux positivity was found in 11 (68%) and history of contact was found in 7 (44%) of patients.

- BCG Scar was absent in 3 (19%) of patients.

- Consolidation was found in 4 (25%) of patients, Consolidation with collapse in 2 (12%) cavity in 2 (12%), Bronchopneumonia in 2 (12%),Intrathoracic Adenopathy in 2 (12%), Miliary TB in 1 (6%), Bronchiectasis and Pleural effusion each in 1 (6%) and 1 patient had normal x-ray.

- GL was positive in 4 (25%) and BAL was positive in 9 (56%) of patients.

TABLE-9

Age wise Analysis of GL & BAL in children with suspected pulmonary tuberculosis

Age	GL (n=15)				BAL (n=20)			
	Smear AFB		AFB Culture		Smear AFB		AFB Culture	
	Positive	Negative	Positive	Negative	Positive	Negative	Positive	Negative
<1year	3	15	3	15	7	11	9	9
1-4 years	4	18	6	16	6	16	9	13
5-8 years	2	9	2	9		11		11
9-12 years	3	7	4	6	1	9	2	8
	12 (20%)		**15 (24.5%)**		**14 (23%)**		**20 (32.7%)**	

GL smear was positive in 12 (20%) of cases while culture was positive in 15 (24.5%), BAL smear was positive in 14 (23%) and culture positivity was found in 20 (32.7%). GL culture was positive in 3 (17%) in <1 year and 6 (27%) 1-4 years, 2 (18%) between 5-8 years, and 4 (40%) between 9-12 years of age. BAL culture was positive in 9 (50%) in <1 year and 9 (40%) between 1-4 years, 2 (20%) between 9-12 years. Both BAL and GL was found positive in 5[8%] patients.

TABLE-10

Analysis of Culture Positive Cases in the Study Population
n=30

Age	Sex		Mantoux		Contact		BCG Scar		Radiology							Bronchoscopy		
	Male	Female	Positive	Negative	Positive	Negative	Present	Absent	Consolidation	Bronchopneumonia	Consolidation With Collapse	Cavity	Bronchiectasis	Pleural Effusion	Miliary TB	Airway Inflammation	EBTB	Normal
<1 year	6	5	2	9	10	1	8	3	2	5	1	2	-	-	1	5	5	1
1-4 years	6	5	7	4	5	6	10	1	6	2	-	1	1	-	-	8	3	-
5-8 years	1	1	2	-	-	2	2	-	2	-	-	-	-	-	-	2	-	-
9-12 years	5	1	5	1	2	4	6	-	3	1	1	-	-	1	-	4	2	-
Total	18 (60%)	12 (40%)	16 (53%)	14 (47%)	17 (57%)		26 (87%)	4 (13%)	13 (43%)	8 (27%)	2 (7%)	3 (10%)	1 (3%)	1 (3%)	1 (3%)	19 (63%)	10 (33%)	1 (3%)

Analysis of 30 AFB culture positive cases of children with suspected pulmonary tuberculosis showed a sex ratio of 18 (60%) boys and 12 (40%) girls. Age distribution was 11 (36.6%) less than one year, and 11 (36.6%) between 1-4 years of age 8 (27%) between 5-12 years of age.

A positive mantoux was present in 16 (53%) and a positive history of contact in 17 (57%). BCG scar was absent in 4 (13%) patients, while one was not immunized, others have been the immunized in the 1st year.

The major radiological findings were segmental lesions in the form of consolidation in 13 (43%) and consolidation with collapse in 2 (7%), persistent bronchopneumonia in 8 (27%) cavity in 3 (10%), miliary TB, Bronchiectasis and pleural effusion each in 1 (3%) patient. One patient had normal chest x-ray, while CT scan showed alveolar hemorrhage and found to have EBTB in bronchoscopy with culture positivity in both GL and BAL.

The major bronchoscopy findings were inflammation of the airways in 19 (63.3%) and EBTB is 10 (33.3%) and 1 (3%) showed normal airway.

DISCUSSION

A total of 61 children were included in the study. There were 37 (60.6%) boys and 24 (39.3%) girls. The observed aged distribution was 65.5% <4years and 34% between 5-12 years. B J Marais et al [42] in his study showed age distribution of 74.9% < 5years and 25 % between 5-12 years of age.

Positive history of contact in our study was identified in 34 (55.7%) and a positive mantoux was observed in 34 (55.7%) of patients.Mantoux reactors were equally distributed between culture positive and culture negative patients. This is comparable to the study done in peru by Guillermo E et al [43] where 51% of patients had a positive mantoux. Meenusingh et al [31] have showed positive mantoux reaction in 40 (68.9%) of patients and a history of contact was found in 32 (55%) of patients.

The common symptoms included cough (96%), Fever (77%), Breathlessness (52%), FTT in (22%), Hemoptysis (6.5%).48[78%]children were malnourished. In a similar study by Meenu singh [31] et al had cough[96%] as a predominant symptom and 76% were malnourished.

The Major radiological features in our study were segmental lesions in the form of consolidation in 29 cases and consolidation with collapse in 5 patients making a total of 34 (55.7%).This is comparable to the study done by Meenu Singh et al [31] where 32 (55%) patients had segmental lesions in the form of consolidation or collapse.

Other findings in our study are Bronchopneumonia in 11 (18%) and cavity in 6 (9.8%) intrathoracic adenopathy in 4 (6.5%), Bronchiectasis in 2 (3.27%) pleural effusion in 2 (3.27%) Miliary TB in 1 (1.63%) and Chest X-ray was normal in 1 patient while CT Scan suggested alveolar hemorrhage with severe narrowing of short segment of distal left main bronchus and bronchoscopy showed left main bronchus was compromised with bleed suggesting granulation tissue.

The major bronchoscopy findings in our study were inflammation of the airways in 32 (52.4%), EBTB in 16 (26%), normal Mucosa in 10 (16%), 2 (3.27%) had external compression of the airways and 1 (1.63%) had bronchiectasis.

EBTB in our study was found in 16 (26%) of patients. The most common age of presentation was 75% <4 years of age. This is comparable to earlier reports that the chances of EBTB are greatest in the first year in 25% and 1-5 years in 10%[44]. Chan S. et al[45] in a study

had analysed 36 children with active pulmonary tuberculosis and found EBTB in 15 (41.7%). The most common radiological findings in EBTB in our study is in the form of segmental lesions such as consolidation in 4 (25%) and consolidation with collapse in 2 (12%). This is in conjunction with earlier study conducted by Ledesma [35] et al where atelectasis, consolidation and hyperinflation were the major radiological findings observed in cases with EBTB.

The results of this study indicate that both BAL and GL cultures are complementary to each other for isolation of mycobacterium tuberculosis in children clinically diagnosed to be suffering from pulmonary tuberculosis.

Mycobacterial isolation rate increased from 24.5% to 49% by the addition of BAL as an investigation.The difference in the recovery rates of mycobacterium tuberculosis by GL and BAL was not stastistically significant.

These results are contrary to earlier reports where gastric lavage proved better than BAL and BAL did not improve the yield of mycobacterium tuberculosis.

Of the 61 cases included in our study, mycobacterium tuberculosis was grown in culture in 15 (24.5%) Gastric lavage samples and 20 BAL (32.7%) Samples making a total of 30 (49%) culture proven cases. Both GL and BAL were positive in 5 patients. In a similar study, done by meenusingh et al,in 1999 had studied 58 children clinically suspected of pulmonary tuberculosis and found that 10 (17.2%) of Gastric lavage samples and 12 (20.6%) BAL samples proved positive for mycobacterium tuberculosis. Overall mycobacterial isolation was 20 (34.4%) as 2 children had grown mycobacterium tuberculosis in both GL and BAL.

In another study done by Abadco et al, [29] comparing the sensitivity of GL with BAL for isolating mycobacterium tuberculosis from 20 children with a presumptive diagnosis of pulmonary tuberculosis. They have found 2 (10%) BAL samples and 8 (40%) GL samples culture positive for mycobacterium tuberculosis making an overall isolation rate of 10 (50%) where 2 had both BAL and GL samples positive for mycobacterium tuberculosis.

Somu et al, [30] from Institute of Child Health, Chennai have studied 50 children with suspected pulmonary tuberculosis. Out of the 50 cases, Mycobacterium tuberculosis was grown in 6 (12%) of BAL

samples and 16 (32%) of GL samples. Both GL and BAL were positive in 5 cases. The overall bacteriologic yield was 17 (34%) while gastric lavage alone was positive in 32% of cases.

Norman et al [38] have studied 63 patients where BAL was performed on 62 patients and Gastric lavage in 60 patients. They have found 13 (21%) culture positive cases in BAL and Gastric lavage was positive only in 7 (11.6%). They concluded that BAL should be performed instead of gastric lavage when pulmonary tuberculosis is suspected.

Dickson et al [32] from United Kingdom, have retrospectively analyzed the medical records of 180 patients with smear negative pulmonary TB in adults. They have found that positive culture yield for BAL 62 (34%) of 180 patients was significantly greater than that for specimens from 3 Gastric washings 32 (21%) of 149 patients.

Kvale et al. [46] reported that the culture of bronchial washings was negative in upto two third of their adult patients with pulmonary tuberculosis.

They used a maximum 600mg of lignocaine during the procedure and suggested that this accounted for the low recovery of mycobacteria

in their patients. Most studies in adults which reported better yield with BAL used lesser amount of lignocaine (200-320 mg). Schmidt and Rosenkranz [47] have demonstrated the inhibition of Mycobacterium tuberculosis by varying concentrations of lignocaine.In our study, Lignocaine was used only at the time of entering the larynx to anesthetize the vocal cords and was not used after entering the trachea. This could have resulted in better yield with BAL in our study.

Meenusingh et al [31] have reported that the timing of BAL could influence the positivity of mycobacterium tuberculosis in Gastric Lavage. If GL is done after BAL there are more chances of GL being positive because BAL facilitates flux of secretions from the airways upwards which are swallowed into the stomach. In our study protocol, BAL was performed on one of the three days when GL was performed.Hence, we conclude when both GL and BAL are used,these procedures complement each other.

CONCLUSION

1. Bronchoalveolar Lavage (BAL) is a useful investigation to aid in the bacteriological diagnosis of childhood pulmonary tuberculosis .

2. There is no difference in mycobacterial isolation rates from GL and BAL When studied in isolation.

3. However, when both gastric lavage[GL] and Bronchoalveolar lavage[BAL] are used for isolation of mycobacterium tuberculosis, these procedures are **COMPLEMENTARY** to each other.

4. Bacteriological yield is **DOUBLED** by the addition of BAL as a diagnostic investigation in children with suspected pulmonary tuberculosis.

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PROFORMA

Name :

Age :

Sex :

IP No :

Place :

Weight : Height / Length:

Nutritional Status:

Norm	U.N	PEM I	PEM II	PEM III	PEM IV

Presenting Complaints:

Past history of Hospitalization:

Past History of ATT:

Past history of any chronic lung disease:

Contact:

Father	Mother	Grandfather	Grandmother	Uncle	Aunt	Sibling	Neighbour	Others

BCG Scar:

No	Yes	When given	Site	Size

Clinical Features:

Mantoux:

Negative	Positive	Size (mm)

TC

DC

HB

Smear study

HIV status:

CXR:

USG Chest: (if needed)

CT Scan: (if Needed)

F.O.B. NO / Date:

Bronchoscopy findings :

Gastric Lavage AFB

Smear	Culture
I	
II	
III	

B.A.L. AFB

Smear	Culture